

**From:** Dellinger, Philip  
**Sent:** Monday, June 22, 2015 8:54 AM  
**To:** Dorsey, Nancy;R6 6WQ-SG;Brown, James;Hildebrandt, Kurt  
**Subject:** RE: two NEW postings a IS

[Soraghan's article on it.](#)

## **EARTHQUAKES: Reduce injection to reduce quakes, but that's not always easy**

[Mike Soraghan](#), E&E reporter

Published: Friday, June 19, 2015

If you want to stop man-made earthquakes, stop injecting so much oil and gas wastewater underground.

That's the fairly simple prescription offered by two studies released yesterday for man-made earthquakes linked to drilling activity.

But that may be easier said than done.

Cutting back on the amount of wastewater injection would cost oil companies money. And the state officials who oversee oil and gas might not have enough authority to enforce steep reductions.

Arkansas imposed a moratorium on disposal wells in a 1,150-square-mile area after they were linked to a string of quakes in 2011.

But in Oklahoma, at the center of the earthquake debate, officials say they don't have the authority to do that.

"It's our understanding we don't have the authority to do a broad-based moratorium," said Matt Skinner, spokesman for the Oklahoma Corporation Commission, which is in charge of regulating oil and gas in the state.

The commission has much more authority to restrict volumes on individual wells, particularly before they are permitted. But one of the two studies yesterday suggests that a one-by-one approach to cutting volumes won't do much if overall, cumulative injection levels remain the same in an area ([E&ENews PM](#), June 18).

"You just can't put an arbitrary limit on how much any individual well should be injecting," said Mark Zoback, a Stanford University geophysicist who authored one of the studies, which focused on Oklahoma. "We really think the important concept is how much water has been injected in those areas."

The Stanford study is particularly relevant for Oklahoma, because Zoback enjoys significant credibility with officials there. His previous findings have been cited by Corporation Commissioner Dana Murphy, and he first met with Gov. Mary Fallin (R) on the issue in June 2013.

He is also perceived as being friendlier to industry than some academics. The Stanford Center for Induced and Triggered Seismicity, of which he is co-director, is an "industrial affiliates program" that counts 20 oil and gas companies as members. Some of them, such as Sandridge Energy Inc. and Continental Resources Inc., are Oklahoma companies with stakes in the earthquake debate.

Zoback's study says there appears to be a level of injection that seismically prone formations can accept without triggering quakes, since there was injection before with no shaking.

But in the Mississippi Lime area of north-central Oklahoma, going back to pre-earthquake levels would require a 90 percent cut. Some companies might well argue that amounts to a kind of moratorium, or at least a *de facto* moratorium.

The Mississippi Lime crosses into Kansas, where officials in March imposed broad but gradual cuts on volume for injection wells. SandRidge, the dominant producer in the area, has kept its options open to challenge the restriction, but so far hasn't moved aggressively ([EnergyWire](#), April 21).

So far, Oklahoma officials haven't followed suit. Instead, they've focused on whether wells were drilled into brittle, fault-riddled bedrock. But they are continuing to consider such a cut as the quakes continue.

"A volume cutback is obviously at the top of our list," Skinner said.

The other study released yesterday, by researchers from the University of Colorado and the U.S. Geological Survey, suggested a focus on high-volume injection wells. Todd Halihan, a geologist at Oklahoma State University, said that could mean some forms of production wouldn't be cost-effective.

"If you want to limit high-rate wells," he said, "that would affect dewatering," a method that produces huge amounts of wastewater.

Disposal is not a side issue for oil producers. Drilling can produce as much water as it does oil, often much more. New Dominion LLC, which pioneered the dewatering method of oil production, can bring up 1,000 barrels of water for every barrel of oil.

Production from the Mississippi Lime also brings up far more water than conventional production. For SandRidge, inexpensive disposal is key to the company's strategy in the play.

The company told investors earlier this year that restrictions related to man-made earthquakes "could materially and adversely affect the company's business, financial condition and results of operations."

The oil industry in Oklahoma reacted tentatively yesterday to the findings in the study.

"The bottom line, as it is suggested in the Zoback paper, is that more study is needed but this gives good guidance and confirms that we are headed in the right direction," Chad Warmington, president of the Oklahoma Oil & Gas Association, said in a statement.

In Texas, state data show that a string of earthquakes outside Fort Worth tapered off shortly after XTO Energy Inc. cut the amount of wastewater it was injecting into a disposal well nearby. And they haven't returned.

But XTO, along with EnerVest Ltd., has mounted a stiff challenge to the suggestion by regulators that their wells be shut down, even after a study by Southern Methodist University found the companies' wells were the most likely cause of the quakes ([EnergyWire](#), June 11).

Scientists have known since the 1960s that injection of industrial waste fluid, whether from drilling or other activities, can cause earthquakes. The fluid can seep into faults, essentially lubricating them and disturbing the equilibrium that kept them from slipping.

Oklahoma had 585 quakes of magnitude 3 or greater last year and is on track for more than 800 this year. Colorado, Ohio and West Virginia have also had quakes attributed by seismologists to waste disposal from oil and gas production.

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**From:** Dorsey, Nancy  
**Sent:** Monday, June 22, 2015 8:31 AM  
**To:** R6 6WQ-SG; Brown, Jamesr; Hildebrandt, Kurt  
**Subject:** FW: two NEW postings a IS

Worth a quick scan...though not new... to us at least.

Mike,

Does this statement sound true, its from the Walsh and Zoback article?

“Because flowback water typically comprises 10 to 30% of fracturing fluid pumped in unconventional horizontal wells, we used 30% to estimate the maximum volume of hydraulic fracturing flow-back water that would need to be disposed of in SWD wells.”

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**From:** Ben Grunewald [<mailto:ben@gwpc.org>]

**Sent:** Friday, June 19, 2015 2:40 PM

**To:** Mike Nickolaus; [Andrew.adgate@dnr.state.oh.us](mailto:Andrew.adgate@dnr.state.oh.us); [sanderson@edf.org](mailto:sanderson@edf.org); [darthur@all-llc.com](mailto:darthur@all-llc.com); [Scott.ausbrooks@arkansas.gov](mailto:Scott.ausbrooks@arkansas.gov); [Brad.Bacon@pdce.com](mailto:Brad.Bacon@pdce.com); [t.baker@occemail.com](mailto:t.baker@occemail.com); [gerry.baker@iogcc.state.ok.us](mailto:gerry.baker@iogcc.state.ok.us); Bates, William; [rabauer@illinois.edu](mailto:rabauer@illinois.edu); [johnbaza@utah.gov](mailto:johnbaza@utah.gov); [Larry.Bengal@aogc.state.ar.us](mailto:Larry.Bengal@aogc.state.ar.us); [beroza@stanford.edu](mailto:beroza@stanford.edu); [bromhal@netl.doe.gov](mailto:bromhal@netl.doe.gov); [rex@kgs.ku.edu](mailto:rex@kgs.ku.edu); [jeff.bull@chk.com](mailto:jeff.bull@chk.com); [Diana.burn@stata.co.us](mailto:Diana.burn@stata.co.us); [ccabarcas@hilcorp.com](mailto:ccabarcas@hilcorp.com); [tcladouhos@altarockenergy.com](mailto:tcladouhos@altarockenergy.com); [dustin.crandall@netl.doe.gov](mailto:dustin.crandall@netl.doe.gov); Dellinger, Philip; [tdohmen@hess.com](mailto:tdohmen@hess.com); Dorsey, Nancy; [Jon.freedman@ge.com](mailto:Jon.freedman@ge.com); [cliff@ig.utexas.edu](mailto:cliff@ig.utexas.edu); [Rod.Gertson@dnv.com](mailto:Rod.Gertson@dnv.com); Green, Holly; [rob.habiger@spectraseis.com](mailto:rob.habiger@spectraseis.com); [Henry.J.Harmon@wv.gov](mailto:Henry.J.Harmon@wv.gov); [dhenry@hilcorp.com](mailto:dhenry@hilcorp.com); [r.hoffman@kcc.ks.gov](mailto:r.hoffman@kcc.ks.gov); [austin.holland@ou.edu](mailto:austin.holland@ou.edu); [roger.kelley@clr.com](mailto:roger.kelley@clr.com); Kenney, James; [bob.koehler@state.co.us](mailto:bob.koehler@state.co.us); [Joslee.jjl@gmail.com](mailto:Joslee.jjl@gmail.com); [C.Lord@occemail.com](mailto:C.Lord@occemail.com); [Hal.Macartney@pxd.com](mailto:Hal.Macartney@pxd.com); [elmajer@lbl.gov](mailto:elmajer@lbl.gov); [shawn.maxwell@itasca-image.com](mailto:shawn.maxwell@itasca-image.com); [hmcdivitt@dnr.IN.gov](mailto:hmcdivitt@dnr.IN.gov); [lmcdonald@sandridgeenergy.com](mailto:lmcdonald@sandridgeenergy.com); [meadows@api.org](mailto:meadows@api.org); [musick\\_ambrose@msn.com](mailto:musick_ambrose@msn.com); [Mark.Nechodom@conservation.ca.gov](mailto:Mark.Nechodom@conservation.ca.gov); [tnein@hilcorp.com](mailto:tnein@hilcorp.com); [Jeffrey.nunn@gmail.com](mailto:Jeffrey.nunn@gmail.com); [kris.j.nygaard@exxonmobil.com](mailto:kris.j.nygaard@exxonmobil.com); Mike Paque; [john.parrish@conservation.ca.gov](mailto:john.parrish@conservation.ca.gov); [DonaldPA@USC.edu](mailto:DonaldPA@USC.edu); [wrish@hullinc.com](mailto:wrish@hullinc.com); [johnrogers@utah.gov](mailto:johnrogers@utah.gov); [brian.rovelli@ge.com](mailto:brian.rovelli@ge.com); [jrubinstein@usgs.gov](mailto:jrubinstein@usgs.gov); [rupp@indiana.edu](mailto:rupp@indiana.edu); [rjsa@chevron.com](mailto:rjsa@chevron.com); [Jesse.sandlin@dnv.com](mailto:Jesse.sandlin@dnv.com); [Leslie.Savage@rrc.state.tx.us](mailto:Leslie.Savage@rrc.state.tx.us); [fernando.sierra@shell.com](mailto:fernando.sierra@shell.com); [Rick.Simmers@dnr.state.oh.us](mailto:Rick.Simmers@dnr.state.oh.us); [Michael.sims@rrc.state.tx.us](mailto:Michael.sims@rrc.state.tx.us); [dsmith@rexenergycorp.com](mailto:dsmith@rexenergycorp.com); [jsmith@anga.us](mailto:jsmith@anga.us); [Edward.steele1@ge.com](mailto:Edward.steele1@ge.com); [stump@smu.edu](mailto:stump@smu.edu); [LauraSwafford@chevron.com](mailto:LauraSwafford@chevron.com); [Michael.Teague@ee.ok.gov](mailto:Michael.Teague@ee.ok.gov); [Mark.thiesse@wyo.gov](mailto:Mark.thiesse@wyo.gov); [Timothy\\_Tyrrell@xtoenergy.com](mailto:Timothy_Tyrrell@xtoenergy.com); [Bob.vanvoorhees@gmail.com](mailto:Bob.vanvoorhees@gmail.com); [john@veilenvvironmental.com](mailto:john@veilenvvironmental.com); [randijwalters@gmail.com](mailto:randijwalters@gmail.com); [norm.warpinski@pinntech.com](mailto:norm.warpinski@pinntech.com); [Kara.williams@chk.com](mailto:Kara.williams@chk.com); [jonathan.winsor@shell.com](mailto:jonathan.winsor@shell.com); [Ivan.Wong@urs.com](mailto:Ivan.Wong@urs.com); [brian.woodard2@chk.com](mailto:brian.woodard2@chk.com); [robert.worstall@dnr.state.oh.us](mailto:robert.worstall@dnr.state.oh.us); [Debby.yost@chk.com](mailto:Debby.yost@chk.com); [Ulrich.Zimmer@shell.com](mailto:Ulrich.Zimmer@shell.com); [zoback@stanford.edu](mailto:zoback@stanford.edu); [craig.pearson@rrc.state.tx.us](mailto:craig.pearson@rrc.state.tx.us); [jfurnace@hilcorp.com](mailto:jfurnace@hilcorp.com); [michael.mathis@clr.com](mailto:michael.mathis@clr.com); [jill.cooper@Anadarko.com](mailto:jill.cooper@Anadarko.com); [m.skinner@occemail.com](mailto:m.skinner@occemail.com); [Diana.Burn@state.co.us](mailto:Diana.Burn@state.co.us); [Jesse.Sandlin@dnv.com](mailto:Jesse.Sandlin@dnv.com)

**Cc:** Mike Paque; Dan Yates; Gerry Baker; Leslie Savage; Matt Kellogg

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See reports attached and at...

<http://www.gwpc.org/resources/induced-seismicity-resources>

THANKS!

Ben Grunewald

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